F3

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 March 2002 (28.03.2002)

PCT

(10) International Publication Number
WO 02/25040 A1

(51) International Patent Classification[7]: E05B 47/00, 49/00, 51/00, B60R 25/00

(21) International Application Number: PCT/AU01/01195

(22) International Filing Date:
24 September 2001 (24.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PR 0305 22 September 2000 (22.09.2000) AU

(71) Applicant *(for all designated States except US)*: **AUSTRALIAN ARROW PTY LTD** [AU/AU]; 45 Lathams Road, Carrum Downs, Victoria 3201 (AU).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **JAMES, Campbell** [AU/AU]; 11 Kunyung Road, Mt Eliza, Victoria 3930 (AU). **KERRY, Leonard** [AU/AU]; 65 Lathams Road, Carrum Downs, Victoria 3201 (AU). **JANKOWSKI, David** [AU/AU]; 65 Lathams Road, Carrum Downs, Victoria 3201 (AU).

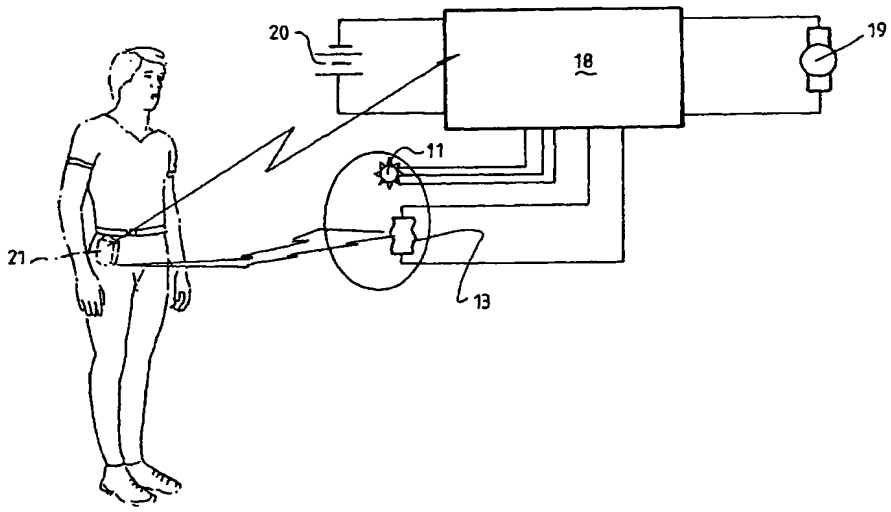
(74) Agent: **FREEHILLS CARTER SMITH BEADLE**; Level 43, 101 Collins Street, Melbourne, Victoria 3000 (AU).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: PROXIMITY ACTIVATED ENTRY SYSTEM



(57) Abstract: A passive entry system to a protected space, especially a motor vehicle, includes a central control station (18) for locking and unlocking doors of the vehicle and providing radio communication to a remote portable electronic identification device (21). The control station (18) is initiated to poll the portable device when the vehicle is locked and a person enters a predetermined sense area around the vehicle. A number of proximity sensors (11) mounted externally of the vehicle, in turn indicator lamps (10) and tail lamps of the vehicle, for example, sense when a person is in the sense area and initiate the control station (18) to poll the identification device (21). Once a valid communication is received by the control station (18) it unlocks the vehicle. Initiation also occurs from an unlocked condition when a person exits the vehicle. Opening and closing of the driver's door initiates polling and when no valid response is received after a predetermined time the vehicle is locked.

WO 02/25040 A1

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE: PROXIMITY ACTIVATED ENTRY SYSTEM

Field of the Invention

This invention relates to passive entry systems, and in particular to passive entry systems such as may be applied to automatic keyless entry for vehicles, buildings or other closed environments.

Background of the Invention

There exists a requirement particularly in the automotive market, for example, for remote keyless entry systems which allow authorised entry to and operation of a vehicle by simply walking up to the vehicle, opening the door, and getting into the vehicle. The operator is identified as being authorised by carrying an electronic identification device. An authorised operator carrying such a device will not be required to press a button on their keyless entry remote control to open the doors. These systems are referred to in the industry as "passive entry" systems.

Typical passive entry systems operate in the following manner:

- The vehicle operator, carrying an electronic identification device approaches the locked vehicle. Upon touching the door handle, the vehicle transmits a message to (polls) the operator's electronic identification device.
- The vehicle's message is received by the operator's electronic identification device which then responds by transmitting a message to the vehicle.
- If the dialogue between vehicle and identification device results in a valid outcome the vehicle is unlocked. The contents of the messages above are encoded by methods known in the art to ensure the security of the process.

Automotive manufacturers who already provide vehicles with conventional keyless entry or central locking systems which require the vehicle operator to press a button on a control have a need to provide passive entry systems to provide an even greater convenience in a cost effective manner. Also, for "new" models there is often a desire to use as many components from previous models as possible. Passive entry systems which are initiated by a touch of the door handle require modifications to existing vehicle components. The door handle must be modified to incorporate a touch sensing mechanism. This is often in the form of a switch

operated when the door handle actuation commences. The door lock actuator will almost undoubtedly perform too slowly, or inappropriately (such as jamming when the handle is moved while the mechanism is unlocking) for a passive entry system, thus requiring further modification to the latch mechanism. In order to overcome the need to modify these components a passive entry system where the vehicle unlocks before the user has touched the handle is considered desirable. Continuous polling by the vehicle can allow the vehicle to unlock before the user has reached the vehicle. However this results in unacceptably high power consumption in the vehicle.

Accordingly, it is desirable to provide an improved passive entry system which overcomes or avoids at least some of the deficiencies of existing systems.

It is also desirable to provide a passive entry system for a vehicle or other environment such as a building, which is economically useful, is able to be adapted for existing systems, and is cost effective.

Summary of the Invention

In accordance with one aspect of the invention there is provided a passive entry system including a central control station for locking and unlocking entry to a protected space and providing radio communication with a remote portable electronic identification device, whereby upon initiation when entry is locked, said control station polls said portable device and upon receipt of a valid communication unlocks access to said protected space, characterised in that, a proximity sensor is mounted adjacent said protected space and electrically connected to said central control station to provide said initiation only when the sensor is activated, such as when a person is within a predetermined sense area of said protected space.

In order that the invention may be more readily understood a particular embodiment will now be described with reference to the accompanying drawings.

Description of the Drawings

Fig. 1 is a logic diagram of the unlocking strategy of a passive entry system of a motor vehicle in accordance with the invention;

Fig. 2 is a similar diagram to Fig. 1 but shows the locking strategy;

Fig. 3 is a schematic diagram of a side indicator lamp assembly incorporating a proximity sensor; and

Fig. 4 is a schematic diagram of a proximity sensor and control.

Description of the Preferred Embodiment

According to this embodiment, a motor vehicle (not shown) is provided with infra-red (IR) sensors (11,13) which cover a sense area along the sides of the vehicle. Other sensing means such as using ultrasonics, or microwave radar may be used but IR sensing has the advantages over the others of small size, ease of waterproofing and insensitivity to mounting near metal.

Specifically, as shown in Fig. 3, side turn indicator lamps, which are normally mounted on the side of the vehicle on the front mudguards, are replaced with a module 10 comprising an infra-red emitting and sensing element 11, an indicator globe or LED 12 for providing the flashing turn signal, and a 125kHz antenna 13. The element 11 is directed rearwardly in the direction of arrow 16, and a similar module on the other side of the vehicle also has the element directed rearwardly. The field of vision of the element is represented by the lines 14. A lens 15 covers the element 11 and the indicator globe or LED 12. The arrow 17 shows the direction of the front of the vehicle.

As shown in Fig. 4, the module 10, or more specifically the element 11 and antenna 13, are electrically connected to a central control station 18 within the vehicle for operating the door lock actuators 19 for locking and unlocking of the vehicle doors in a manner known, per se. The central control station 18 is connected to the vehicle battery 20 which provides power for the IR element 11. When a person approaches the vehicle within the area covered by the "field of vision" of IR element 11, the infra-red movement detector detects the movement of the person and signals the central control station 18 to commence polling a polling signal is transmitted by the antenna 13. If the person is carrying an electronic identification device 21 which communicates by way of a valid exchange with said control station 18 during polling, the vehicle is unlocked and the engine may be started without the use of an ignition key.

Whilst in accordance with the above embodiment the proximity sensors are

mounted in the side indicator lights and directed rearwardly therefrom, clearly, additional or alternative arrangements of the proximity sensors can be implemented. For example, extra or alternative sensors can be arranged in vehicle tail lamp assemblies either to provide sensing around the trunk area at the rear of the vehicle (to facilitate access to the trunk) or to contain IR sensing elements for cooperating with IR emitter elements in the respective side turn indicators whereby a change in reflectivity is detected during the presence of a person in the sense area.

Also, proximity sensors may be mounted in the door handles of at least the front doors in order to detect a person approaching the vehicle from the side.

Referring now to Fig.1 the sequence of logic steps involved in the unlocking of a vehicle are clearly shown. In the case where a proximity sensor is triggered by the presence of a person moving within the sense area defined by the lines 14 the portable device (key) is polled and if a valid response is received from the key the vehicle is unlocked.

As shown in Fig. 2 the locking strategy is as follows. Firstly, the vehicle is in the unlocked state. The system 'waits' for the driver's door to open and after opening and closing of the driver's door the system polls outside the driver's door to detect a valid response from the 'key'. If a valid response is received from the key (meaning the driver is outside and within close proximity of the vehicle) the system goes into a loop until there is no valid response from the 'key', indicating the driver has left the proximity of the vehicle. The system, after a predetermined timeout then polls inside the vehicle cabin and in the absence of a valid response from within, locks the vehicle. Other strategies, such as when a valid response is received from within the vehicle, are apparent from the logic diagram of Fig. 2.

It should be apparent from the above that the present invention provides an improved passive entry system which overcomes the deficiencies of previously known systems and avoids continuous power consumption which would ultimately drain the car battery. Various alternatives are discussed in relation to the type and location of the proximity sensors and in one case the emitter and detector of the sensors are separately located with the advantage that electrical coupling between the transmit and receive circuitry is effectively eliminated. This allows greater gain

in the receiver with a consequent increase in detection sensitivity. Other types and locations of proximity sensors may be utilised without departing from the scope of the invention.

Whilst the invention has been described with reference to the passive entry and exit of a motor vehicle, it will be apparent that the system of the invention may be applied to non-automotive applications where automatic secure access is required and similar issues of response time and non-continuous radio frequency polling is desirable.

CLAIMS:

1. A passive entry system including a central control station for locking and unlocking entry to a protected space and providing radio communication with a remote portable electronic identification device, whereby upon initiation when entry is locked, said control station polls said portable device and upon receipt of a valid communication unlocks access to said protected space, characterised in that, a proximity sensor is mounted adjacent said protected space and electrically connected to said central control station to provide said initiation only when a person is within a predetermined sense area of said protected space.

2. A system according to claim 1, characterised in that, said protected space is inside a motor vehicle and said central control station is adapted to unlock one or more doors of said vehicle upon receipt of said valid transmission.

3. A system according to claim 2 characterised in that, said control station is initiated when entry is unlocked and after the driver's door of the vehicle opens and closes, and continues polling outside said driver's door until no valid communication is received from said portable device, when no valid response is received and after a predetermined timeout said control station polls inside said vehicle and in the absence of a valid communication locks said vehicle.

4. A system according to claim 3, characterised in that said proximity sensor comprises a plurality of separate infra-red (IR) sensors at least some of which are mounted inside turn indicator lamps, respectively, of said vehicle and directed rearwardly to sense the presence of a person in an area outside said vehicle and extending along the sides of the vehicle.

5. A system according to claim 3, characterised in that said proximity sensor comprises sensors modules located in tail lamp assemblies with IR sensor elements directed towards the front of the vehicle along each side, respectively, and IR emitter elements are mounted inside twin indicator lamp assemblies towards the front of the vehicle and directed rearwardly, whereby a person moving in the region between respective assemblies is detected by a change in reflectivity in the sense area.

6. A system according to claim 3, characterised in that, said proximity

sensor comprises separate sensors mounted in one or more respective door handle mechanisms on one or both sides of said vehicle and possibly at the rear latch release.

7. A system according to claim 3, characterised in that, said proximity sensor comprises respective sensor modules in the side turn indicators of said vehicle, each module incorporating an IR emitter element and an antenna suitable for communication between said vehicle and said portable device.

8. A system according to claim 3 or 4, characterised in that, said proximity sensor further comprises sensors fitted within tail lamp assemblies of the vehicle to provide sensing around the rear of said vehicle whereby unlocking of the vehicle to provide access to the vehicle trunk or tailgate is facilitated.

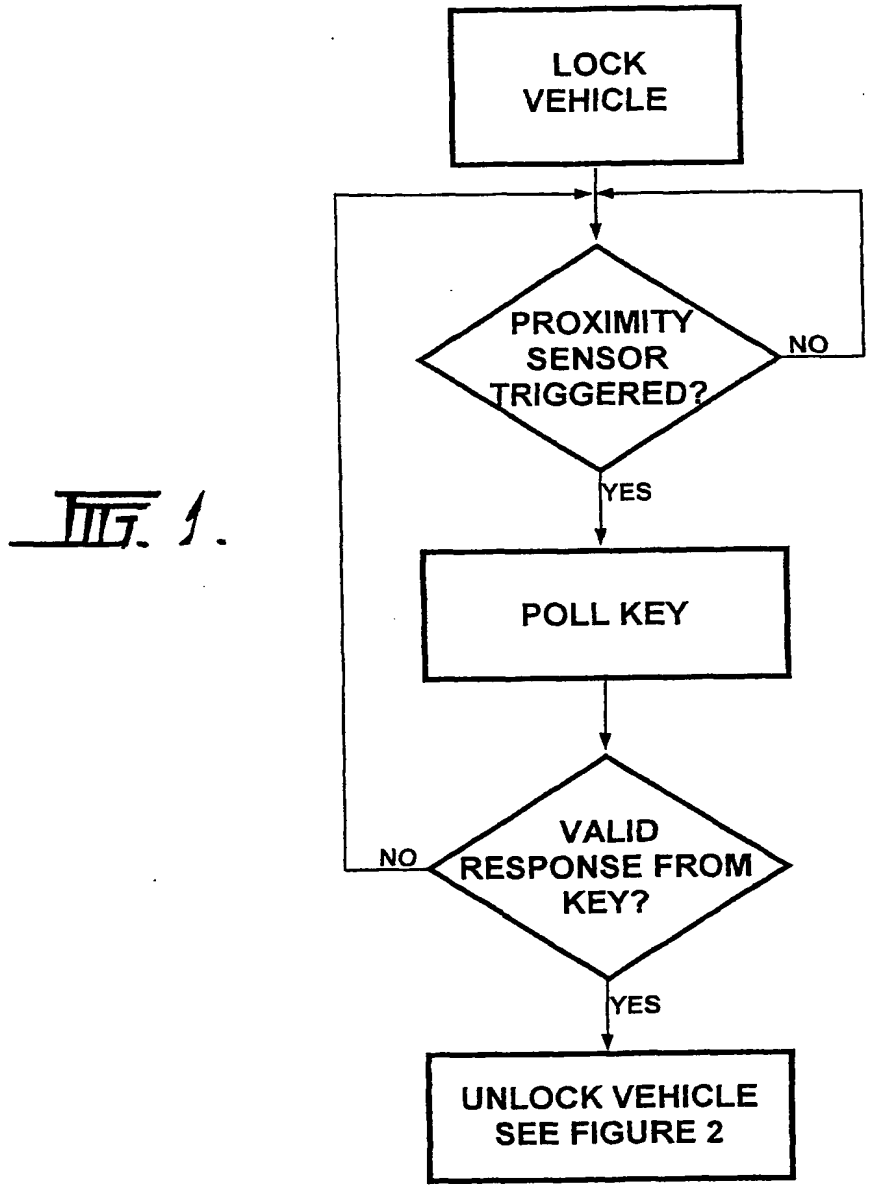

LOCK VEHICLE
PROXIMITY SENSOR TRIGGERED?
NO
YES
POLL KEY
VALID RESPONSE FROM KEY?
NO
YES
UNLOCK VEHICLE SEE FIGURE 2

FIG. 1.

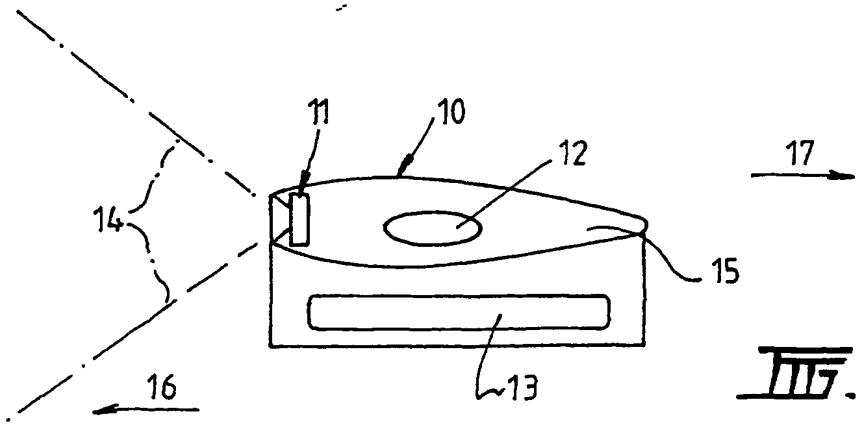

11
10
12
17
14
15
16
13

FIG. 3.

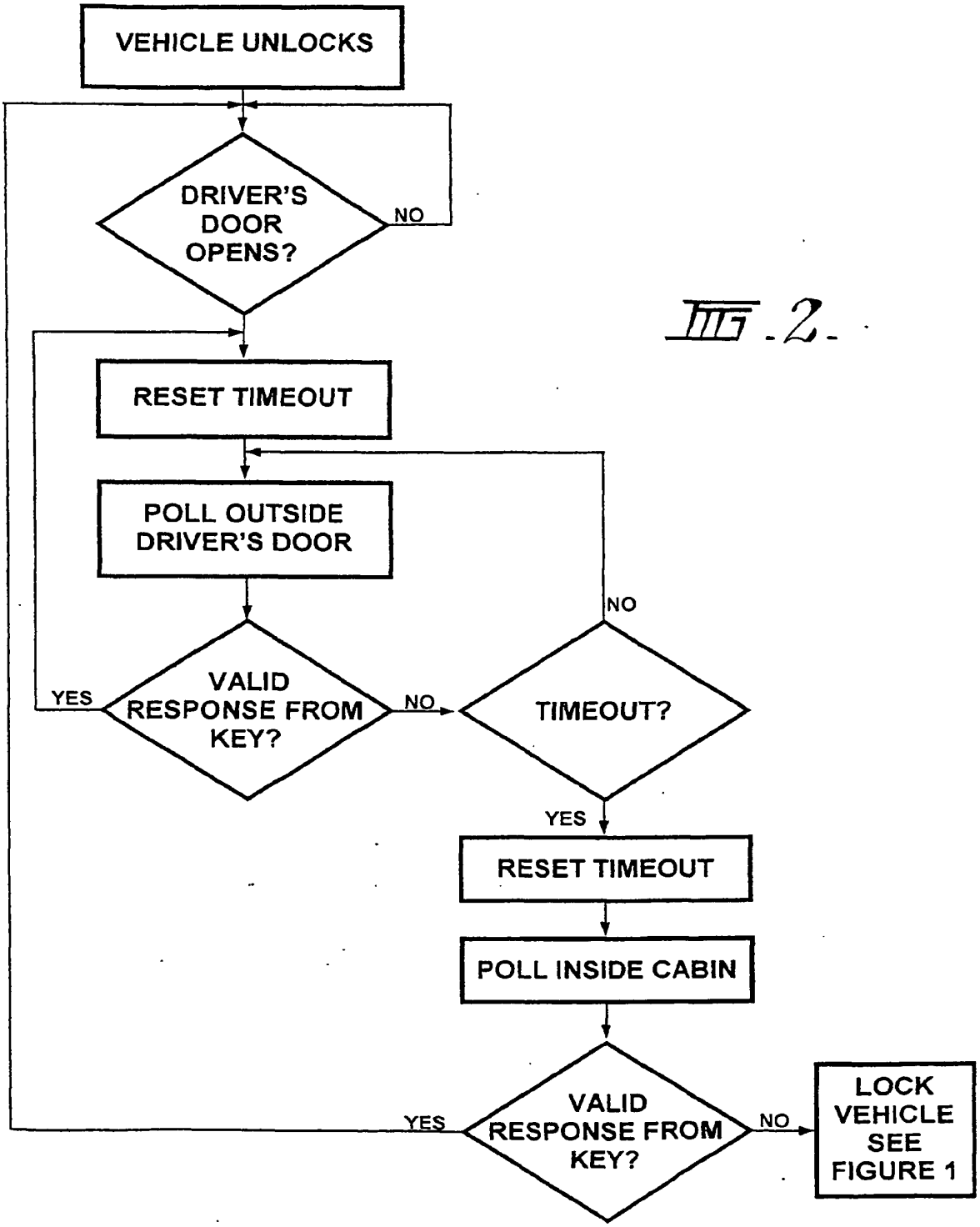

VEHICLE UNLOCKS
DRIVER'S DOOR OPENS?
NO
RESET TIMEOUT
POLL OUTSIDE DRIVER'S DOOR
VALID RESPONSE FROM KEY?
YES
NO
TIMEOUT?
NO
YES
RESET TIMEOUT
POLL INSIDE CABIN
VALID RESPONSE FROM KEY?
YES
NO
LOCK VEHICLE SEE FIGURE 1

FIG. 2.

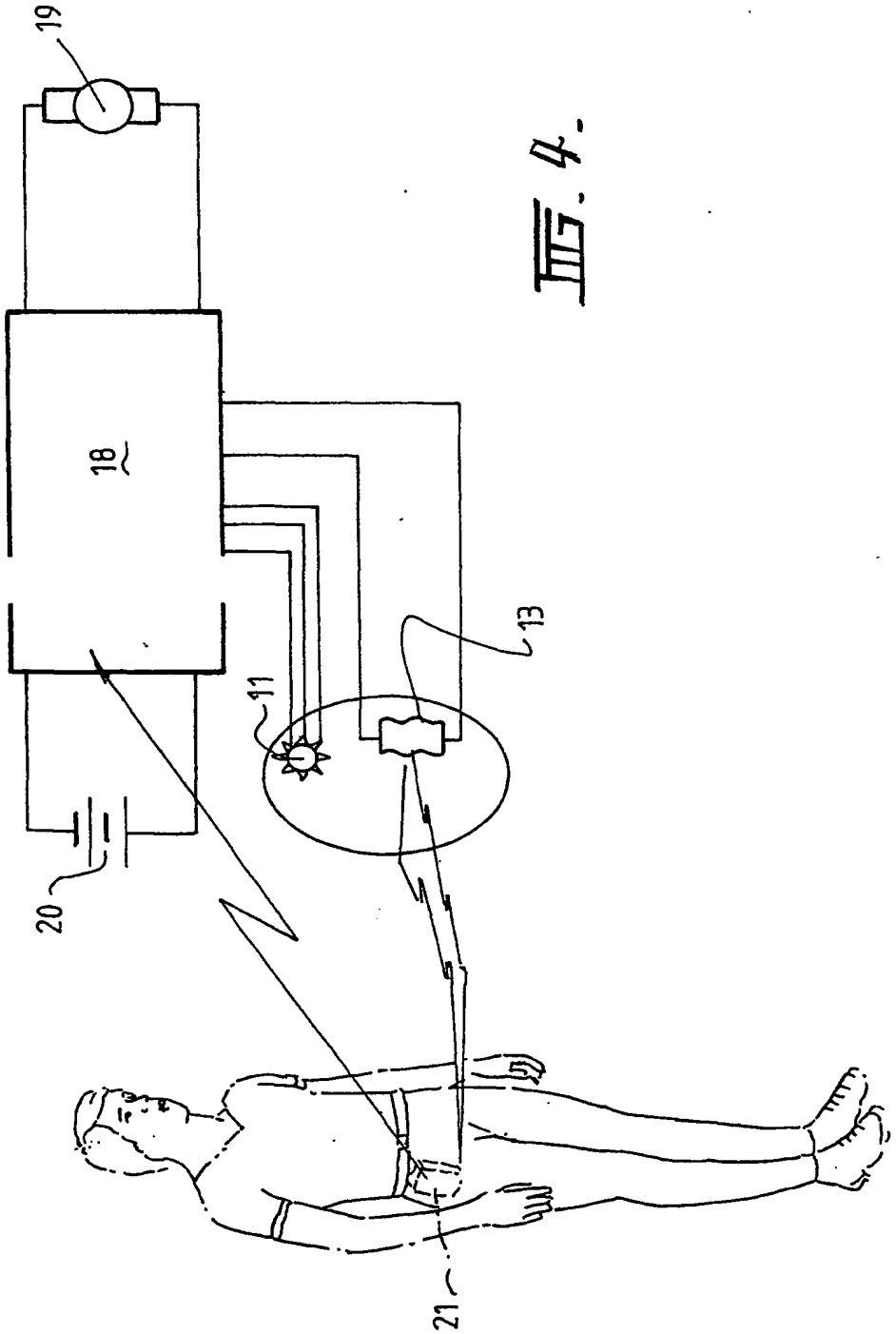


Fig. 4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU01/01195

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: E05B 47/00, 49/00, 51/00, B60R 25/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (7) : E05B 47/00, 49/00, 51/00, B60R 25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 965710 A (TOYOTA J K K) 22 December 1999	1-8
X	EP 999102 A (BOSCH GmbH) 10 May 2000	1-8
X	WO 99/66158 A (LEAR AUTOMOTIVE DEARBORN) 23 December 1999	1-8
X	FR 2778980 A (VALEO SECURITE HABITACLE) 26 November 1999	1-8
Y	EP 984123 A (DAIMLER CHRYSLER AG) 8 May 2000	1-8
Y	EP 1033585 A (DAIMLER CHRYSLER AG) 6 September 2000	1-8
Y	US 5983347 A (DAIMLER CHRYSLER AG) 9 November 1999	1-8

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search
26 October 2001

Date of mailing of the international search report
30 OCT 2001

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

DAVID LEE
Telephone No : (02) 6283 2107

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU01/01195

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
EP	965710	JP	2000073635		
EP	999102	DE	19851177		
WO	9966158	EP	1095198	US	6236333
FR	2778980	NONE			
EP	984123	JP	2000118354		
EP	1033585	DE	19909140	JP	2000275328
EP	823520	DE	19632025	US	5983347

END OF ANNEX